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ABSTRACT

The Rural and Small Schools Conference has made a special effort to address the needs that pertain to science educators in rural and small schools. This publication presents the proceedings from the 1988 science education section of the conference. The content of the conference deals with a diversity of topics. The proceedings include a preface and abstracts of papers from seven sessions dealing with the following topics: the needs of teachers in rural school districts in Kansas; improving science education in rural schools; science teaching equipment; science teacher preparation and networking; adult science education; computer science education; creation and evolution; career education; cooperative learning; and student research. (CW)

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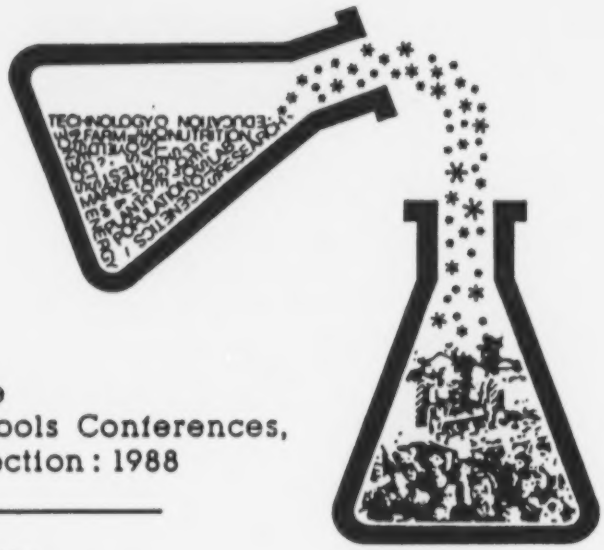

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Kansas State University
Manhattan, Kansas

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PROCEEDINGS

of the

Science Education Section

of the

10th Annual RURAL AND SMALL SCHOOLS CONFERENCE

J. Steve Oliver
Editor

Center for Science Education
Kansas State University
Manhattan, Kansas 66506

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PREFACE

This year the Science Education section of the Rural and Small Schools Conference enters its fourth year. Including science education in the conference has allowed a special opportunity for science educators from around the nation to meet and discuss the rural and small school setting. We are again pleased with the quality and diversity of programs presented in the program.

Diversity is a key word in discussing the program of Rural and Small Schools Conference. For instance, there are papers that deal with identifying needs of science teachers in rural schools, networking rural science teachers for better communications and exchange of information, providing inservice to rural science teachers, and preparing science teachers to teach in rural schools. In addition, there are papers that deal with curriculum and instruction innovations, developing inexpensive equipment for the science laboratory in rural schools, and teaching controversial issues.

The staff and faculty of the Center for Science Education at Kansas State University hope that you have a rewarding experience at the Rural and Small Schools Conference. We hope that you will feel free to contact us at any time. A combined proceedings from previous conferences is available for $ 6.00.

J. Steve Oliver, Editor

PERCEIVED NEEDS AND STATUS OF SECONDARY RURAL SCIENCE TEACHERS IN KANSAS

Emmett L. Wright, Larry G. Enochs, and J. Steve Oliver
Center for Science Education
Kansas State University
Manhattan, Kansas

In order to make science teacher preparation, both preservice and inservice, more effective, it is essential that we first analyze the perceived needs and current status of the target population. This study was designed to assess the perceived needs and status of secondary science teachers in Kansas. Secondary science teachers, as well as teachers as a whole, have received criticism regarding their competencies and their lack of accountability in terms of student science achievement. If we are to assist teachers in their instructional improvement, we must design both preservice and inservice programs that meet the needs of teachers to be involved.

The instrument used in this study, "Kansas Science Teaching Needs Inventory", was developed through modifying a survey instrument by Padilla, et al., (1983). Demographic items were changed to reflect the special characteristics of Kansas schools, e.g. school size, grade level breakdown, etc. In addition, items were added to assess the viability of various graduate course offerings, preferred times, and inservice topics. The instrument was four pages in length and consisted of the following sections:

1. Personal Information;
2. Teaching Strategies;
3. District Information;
4. Status of Science Educators;
5. Inservice Needs;
6. Science Curriculum; and
7. Materials.

The instrument was mailed to all secondary science teachers in Kansas, after purging the State Department of Education mailing list of duplicate entries. A total of 1,100 surveys was mailed. Of these, 405 were returned. No follow-up was done.

The study indicated that there are similarities between rural and non-rural teachers. One of the highest concerns was in regard to the use of microcomputers. Also, teachers were highly interested in taking science content courses. It was also clear that teachers are not using the latest innovations and instructional techniques. Science teachers did express a strong interest for inservice in science content, instructional materials and new teaching strategies, with high preference for summer course offerings.

THE SCI-TECH NETWORK: INFORMATION FOR ALL

James A. Zuhn and Robert K. James
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Texas A & M University
College Station, Texas

We are repeatedly reminded that the world in which we live is not the world in which our students will spend their adult lives. Realizing how our lives and our environment is increasingly impacted by technology, it is imperative that today's students develop clear concepts of how use or abuse of resources today determines the environment in which they will live tomorrow. Considering how our lives are presently affected by electronic devices and limitless information, it is clear that tomorrow's citizens must be able to use technology effectively or they will be overwhelmed by it.

In order to become scientifically and culturally literate citizens in a technological society, students must learn to use current information to constantly update a changing knowledge base and to apply their knowledge in responsible problem-solving and prudent decision-making. Tomorrow's citizens will need to comprehend the world in terms broader than their immediate horizons to realize international, multicultural interdependence. Since technology is at the heart of our changing world, it must be part of the students' learning experiences.

The SCI-TECH CURRICULUM PROJECT at Texas A & M University is working to introduce innovative technology into environmental science instruction. Activity-oriented curriculum materials are currently being developed and used to help students to measure and describe their own life-space. Through these activities, students discover environmental interrelationships of living and non-living features, as well as the impact of human intervention. By analyzing changes over time, they begin to recognize effects of wise or unside management. In response to their discoveries, students evaluate current practices and synthesize new solutions to local problems. To enhance these investigations, students use in their classrooms such innovative technologies as local aerial photography, "live" weather satellite imagery, and computers interfaced with environmental sensors.

Central to this effort is the SCI-TECH NETWORK. This electronic network is being designed to encourage students to become involved in real scientific investigations, coached by research scientists and using real-time data from the real world. Through this network, teachers and their students are able to receive and analyze current data related to animal migrations, weather, sea surface temperatures and currents, earthquakes, vegetation growth, and more. A students communicate ideas and share information among peers in distant places, their horizons are continually extended, helping them to recognize their roles as responsible citizens, not only of their local region, but also of the world community.

USING AIMS (ACTIVITIES INTEGRATING MATHEMATICS AND SCIENCE) MATERIALS IN THE CLASSROOM

Kevin D. Finson
Dept. of Elementary Education/Reading
Western Illinois University
Macomb, Illinois

The first portion of this session will be a brief report on the use of AIMS (Activities to Integrate Mathematics and Science) materials in an actual classroom setting. In this classroom study, the effectiveness of the integration of science and math was examined to determine what impact, if any, an integrated unit using the AIMS materials would have on fourth grade students' attitudes toward science and their comprehension of concepts relating to weather. Pretests and posttests for both attitudes and comprehension were used. Analysis of test data revealed positive (although not significant) gains in attitudes for students who experienced the AIMS activities, and significant gains in comprehension for those same students. As a follow up to this brief report, one of two sample AIMS activities such as those used in the study's classroom will be conducted with session participants to help them gain a better understanding of the materials and classroom efforts reported here.

THE NEW MEXICO RURAL SCIENCE EDUCATION PROJECT: IMPROVING SCIENCE EDUCATION IN RURAL SCHOOLS

Jeffry Gottfried
Chief of Education
New Mexico Museum of Natural History
Albuquerque, New Mexico

and

Judy Dacus
Center for Rural Education
New Mexico State University
Las Cruces, New Mexico

The New Mexico Rural Science Education Project serves as a model for improving science education in rural schools. Under National Science Foundation sponsorship, project staff from the New Mexico Museum of Natural History and the Center for Rural Education at New Mexico State University have traveled tens of thousands of miles to instruct rural teachers in how to teach science using local natural resources.

The NMRSEP approach capitalizes on the natural settings of rural schools and the unique capabilities of museums of natural history. Through participation in workshops, field trips, and Natural History Field Schools (outdoor natural science festivals) rural teachers learn about the wildlife, plants, rocks and fossils of their area and how to develop activities that teach science process skills and that center on locally available natural history specimens and other inexpensive items.

INEXPENSIVE PHYSICS EQUIPMENT FOR LABORATORY AND DEMONSTRATION EXERCISES

Lawrence E. Poorman
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Indiana State University
Terre Haute, Indiana

Several inexpensive pieces of equipment will be used to illustrate other uses in examining concepts in physics. These items have been collected from cereal boxes, table favors, advertisement gimmicks, etc., in forty years of experience. Experience ranges from K through graduate school and very small to very large schools, both rural and urban.

Items included are: boomerangs, frisbees, Tony the Tiger Divers, jumping springs, and many others. Participants can handle any item shown and will receive a one-sheet description of how and where each item has been successfully used in Physics classes.

ENHANCING THE SCIENCE LEARNING ENVIRONMENT THROUGH CHANGE IN FACILITY AND CURRICULUM

Jon W. Brown and Renee Trewyn
Baxter Springs High School
Baxter Springs, Kansas

Although Baxter Springs High School is a relatively young facility, less than fifteen years old, its science facility appeared to me as a first year principal as inadequate. After discussion with my current physics-chemistry teacher, who came after the building was built, I found a mutual concern. Our Building Needs Assessment Committee had some suggestions. What resulted is what our presentation would be about. Mutual cooperation between teacher, administration and Board of Education to create a superior science facility out of a mediocre one. The change was from the existing room to another larger classroom in the same building. Although we will have a new modern science room, it will be in the existing facility. Thus for 1988-89 school year we have a new modern facility and a new curriculum.

LOGOS, LEGOS, ROBOTICS AND SCIENCE EDUCATION

Jackson A. Byars
Divsion of Teacher Education
Kansas State University
Manhattan, Kansas

The LEGO TC LOGO system combines the Apple II microcomputer, an assembly of LEGO parts, and the LOGO computer language into an introduction to robotics appropriate for use from middle level to senior high school. Students build machines powered by small electric motors and program their behavior using an adaptation of the LOGO computer language. Photo and touch sensors make it possible for a study of artificial intelligence.

The collection of a number of short procedures into a longer computer program shows the fundamental structure of many higher level computer languages.

The teacher materials provided encourage exploration, data collection, and problem solving approaches. The concepts covered include velocity, power, friction, mechanical advantage through gear ratios. The entry level activities are simple enough for an average middle level student. The open-ended ideas for further exploration, give possibilities for continued learning for the advanced student. This breadth of usage makes this an excellent resource for the teacher in a small school setting.

In Summer 1988 the presenter taught a number of teachers, some from small schools, to use this system. Projects from this class will be demonstrated.

SCIENCE TEACHER PREPARATION IN SMALL RURAL COLLEGES

Kevin D. Finson
Dept. of Elementary Education/Reading
Western Illinois University
Macomb, Illinois

Small rural colleges face many of the same challenges in education that confront rural elementary and secondary schools --including widely dispersed student populations, lack of networking between schools, little flexibility in monies allocations, large distances between attendance centers, professional isolationism, and the need to find and retain qualified faculty capable of teaching a wide range of subjects --particularly the sciences.

These types of rural problems impact teacher education programs at small colleges in rural settings. The small college must develop programs capable of producing the types of teachers required in their regions while at the same time conforming to budgetary time, and faculty limitations which impact such colleges far more than in more populous college areas.

The problems facing rural colleges in providing in-service to rural teachers, developing and disseminating science curriculum innovations to rural schools, developing research strategies (and conducting research) from such colleges, and other pertinent concerns all vary from similar problems encountered by larger colleges not in extensively rural locales. These problems will be presented and discussed, with one goal of the discussion being the generation and exchange of ideas and/or strategies useful for establishing objectives attainable by small rural colleges for the improvement of the efficiency and effectiveness of their teacher education programs, particularly in science education, and especially in light of recent NCATE/NSTA guidelines.

AN ELECTRONIC MAIL NETWORK FOR RURAL SCIENCE TEACHERS

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Kansas State University
Manhattan, Kansas

and

J. Steve Oliver
Center for Science Education
Kansas State University
Manhattan, Kansas

An electronic mail network has been set up to address the problem of communication among science teachers in Kansas. Thirty-three science teachers, who took part in a summer workshop on teaching modern genetics at Kansas State University are participating in the network. The participants received a Zenith Z-159 computer with a 1200 baud internal modem to use in their classroom. As a condition of admission to the program, each participant's school administrator agreed to make a telephone line available to provide access to the network. The program is supported by the National Science Foundation.

The electronic mail network makes use of BITNET (Because It's Time NETwork), an international electronic mail network. Using this framework, a Bulletin Board was developed for workshop participants and faculty to communicate. The Kansas State University Academic mainframe computer serves as the host computer for the bulletin board. The bulletin board enables the participants to communicate in private with any other person on the participants list or with all of the members of the group at one time. In addition, there is an "open line", to permit a participant to remain anonymous and ask a question or make a comment. BITNET makes most of the bulletin board features available to anyone with acess to a computer on the network. In Kansas, this currently includes Kansas State Univeristy, Wichita State University, the University of Kansas, and the University of Kansas Medical School.

The aim of the program is to provide an avenue for discussion and interaction among the science teachers in Kansas. Preliminary evaluation supports our expectations that the considerable distance between schools and the small size of the typical secondary school enhances the value of this medium of communications and exchange of information. Evaluation of the project will continue throughout the next two years.

FOSTERING COOPERATION BETWEEN COGNATE SCIENCE AND SCIENCE EDUCATION: ONE SMALL COLLEGE ADVANTAGE

Brenda K. Johnson
Science and Mathematics Education
Sioux Falls College
Sioux Falls, South Dakota

Differing perspectives, goals, and underlying beliefs between science instructors in cognate science* and science educators** has affected the direction(s) of reform in science teaching since the early 1980's. Wayne Welch's position paper, Research in Science Education: Review and Recommendations in 1983 , concluded that little what makes a teacher effective has been studied. Sometimes parallel, sometimes divergent goals of various leadership organizations such as NSTA, AAAS, AETS, NARST, and NSF have highlighted the need for reform in teacher behavior through volumes of study of teacher behavior without the concomitant research questioning the goals of science education and the criteria for determining teacher effectiveness (Yager, Penick, et al., 1988).

Local campus differing perspectives, goals, and underlying beliefs between science instructors and science educators telescope the national leadership organizations. Various efforts at joint committees, teaching appointments shared between two disciplines, and changes in job descriptions announced in the Chronicle of Higher Education are some ways institutions have responded to the need for cooperation between the two groups.

On the campus of Sioux Falls College, a small, private, liberal arts college in the upper Midwest, the need for developing more cooperation between instructors of science and science educators exists. One effort toward building that cooperation has been through the implementation of a Title II inservice for elementary teachers. The focus of the grant was to enhance teachers' knowledge base and application of selected science, mathematics, and computer concepts to the classroom. Instructors from both cognate science and science education taught the concepts. The small size of the institution, along with the willingness of the instructors, seemed to aid the implementation of the grant and enhance the cooperation of the two disciplines. In this paper, I will report factors that influenced the cooperation of the cognate and science education instructors in the project, through interviews with the instructors.

THE PENNSYLVANIA INITIATIVE - TAKING SCIENCE AND COMPUTER EDUCATION TO RURAL TEACHERS

Bruce G. Smith, Ken R. Mechling, and Sue Zamzow
Clarion University
Clarion, Pennsylvania

Two unique and successful programs are currently in progress statewide in Pennsylvania in an effort to equalize the inservice education opportunities for teachers.

The Pennsylvania Science Teachers Education Program, (PA STEP) began in 1983 and has serviced the science education needs of nearly 5,000 science teachers and administrators at approximately 25 sites across the state. While some of the courses are offered at urban colleges and universities, the majority are offered at rural colleges and universities. In areas far removed from even a rural institution of higher education, PA STEP courses are offered through state Intermediate Units, or even individual school districts. All PA STEP courses are graduate-level courses, varying in credit from 1 to 3 credits, free to teachers through tuition scholarships by the funding source, the Pennsylvania Higher Education Assistance Agency.

The Information Technology Education for the Commonwealth (ITEC) program began in 1985 with appropriations from the Pennsylvania General Assembly of four million dollars annually to balance the microcomputer education opportunity for all students through a program of inservice teacher education and school district grants. The basic premise of the entire program was to specifically aid the small rural districts otherwise closed out of the grant programs. Like PA STEP, ITEC offers graduate courses free to teachers at fourteen sites across the state and at many small isolated towns through the outreach program. Since the beginning of the program over 10,000 teachers have participated and 271 grants for over 7 million dollars have been disbursed.

SCIENCE EDUCATION FOR OUT-OF-SCHOOL ADULTS: AN EMERGING CHALLENGE FOR RURAL SCHOOL SYSTEMS

J. Preston Prather
Science and Mathematics Education
The University of Tennessee at Martin
Martin, Tennessee

A 1979 National Science Foundation Survey indicated that about ninety-three percent of the nation's adults may be classified as scientifically illiterate. In an era when lifelong science learning is increasingly important, most adults lack a basic science background for further science education. Given predicted occupational transitions over the next two decades, millions of skilled laborers and factory workers who once felt secure in their employment will find themselves vulnerable in a rapidly changing job market caused by automation, robotics, and/or industrial shutdowns. This will be an especially severe sociocultural problem for rural communities where much of the population may derive income from one or a few industrial plants. As these citizens realize the need for additional science learning, millions will turn to local educational agencies for help. Many will lack the money, mobility, or prerequisite training to pursue science education through other channels. Displaced workers who feel disenfranchised and disillusioned due to scientific illiteracy may expect local science teachers, by virtue of their title and training, to provide the needed training. This program will examine the principles of adult/continuing education for insight into possible options for rural and small school systems that may face this impending, socioculturally volatile challenge.

CREATION VERSUS EVOLUTION: A BELIEF IN BOTH?

Lawrence C. Scharmann
Center for Science Education
Kansas State University
Manhattan, Kansas

Biologists often refer to evolutionary theory as the most significant unifying theme upon which biology, as a discipline of study, currently is based. Many biology teachers have experienced frustration, challenges, and even criticism when this topic is planned or presented as a unit of instruction. The issue is certainly a sensitive one and the potential confrontation it engenders is very real. But, should there necessarily be a confrontation between evolutionary theory and biblically-based creation origins? What, if any, are the major options for helping our students resolve their own beliefs while combining science with a belief in a Creator? How do these compare with the scientific evidence on: the age of the universe, age of the earth, the formation of the geological record, the sequence of the appearance of different life forms and the processes of macroevolutionary change? In what sense are these just theories? This position paper, in part, responds to these questions and offers alternate strategies for tactfully handling a potentially controversial issue.

COOPERATIVE LEARNING FOR EXCELLENCE IN SCIENCE

Dan Tredway
School of Education
Western State College
Gunnison, Colorado

Cooperative learning has been present in small schools since schooling has existed and very probably before schooling became formalized. The idea of younger people being helped and guided by older people is basic to societies. Intuitive teachers have used this strategy to improve pupil learning and to extend instructional opportunities for pupils.

This is a concept for enhancing learning whose "time has come" in the sense that it is being institutionalized and applied formally in a variety of school settings.

This presentation will provide examples of cooperative learning from several small school projects in science teaching that are at the present moment in various stages of development.

These projects to be presented will describe school programs with pupils at various levels working together. Some of these examples of science learning experiences include cooperative programs involving pupils at middle school level working with elementary pupils and pupils at senior high school level working with middle school and elementary pupils.

Specific examples of values and information to be gained by both older and younger pupils involved in this cooperative experience will be discussed.

The summary for the presentation will be specifics for initiating such a science program in a small school setting. It will include suggestions for teacher cooperation, preparing both groups of pupils and strategies for evaluation.

ENCOURAGING RURAL YOUTH TO CONSIDER CAREERS IN SCIENCE AND TECHNOLOGY

Susan K. Zamzow
Peirce Science Center
Clarion University
Clarion, Pennsylvania

The Center for Rural Pennsylvania of the Pennsylvania House of Representatives has funded a project entitled, "Encouraging Rural Youth to Consider Careers in Science and Technology", for the summer of 1988. The purposes of this research and community/public service project are to increase the visibility of scientific and technological career choices as a service to rural youth ages 10-14, to establish rural public libraries as sources of science-related career information, expand career orientation in area schools and, in the longer term, to encourage career choices which contribute to the future growth and development of a dynamic rural Pennsylvania.

During the summer of 1988, project staff from Clarion University working with rural librarians, will prepare scientific and technological personnel e.g. chemists, pharmacists, physicians, computer scientists, engineers and others to involve rural youth in hands-on activities related to their careers while sharing career information. For example, a hydrologist may have them investigate stream flow or a chemist may use a crystal-growing activity. Activities will be followed by career information and interaction with the young people about preparation and occupational responsibilities.

Project activities, coordinated through the Center for Science Education at Clarion University, will be conducted at community libraries throughout a nine-county (Cameron, Clarion, Clearfield, Elk, Forest, Jefferson, McKean, Potter, and Warren) rural area in northwestern Pennsylvania. Each library will serve as host-site for three science and technology career programs. After assessing currently available science-related career orientation resources, each library will then be provided with books and resource materials related to science and technology careers, enabling both the libraries and the librarians to serve as long-term resources for science and technology career information. The project is a rural dissemination model designed to increase science-related career awareness among approximately 400 young people and to increase the science and technology career orientation capabilities in libraries in nine rural counties of Pennsylvania.

The project will also strive to encourage expanded career orientation in rural schools of the nine county area of northwestern Pennsylvania. All area school guidance counselors, teachers of science and librarians are invited to attend a Science and Technology Career Orientation Conference at the Center of Science Education of Clarion University during the 1988-89 school year.

A SCIENTIFIC RESEARCH EXPERIENCE FOR STUDENTS

Donald T. Powers
Center for Science Education
Kansas State University
Manhattan, Kansas

The Kansas Junior Academy of Science (KJAS) sponsors a program to develop research skills in junior high and senior high students. Students are encouraged to develop a project in science or mathematics and conduct research. The results of their project are then presented at a district meeting in the Spring, 1989. Projects judged to be superior are then presented at a state meeting. The best paper in Kansas will be presented at the American Association for the Advancement of Science National Meeting.

The purpose of KJAS is to encourage students to develop skills in researching, to meet other scientists and to provide students with the opportunities to present research finding in public. Participants will receive information on how to become part of the Kansas Junior Academy of Science. Handbooks will also be available as well as information on how schools many qualify for student research grants.

THE ELEMENTARY SCIENCE EDUCATION INSTITUTE MODEL FOR ENRICHMENT OF RURAL SCIENCE INSTRUCTION

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Center of Excellence for the Enrichment of
Science and Mathematics Education
The University of Tennessee at Martin
Martin, Tennessee

The need for reform of science education is a major national issue. The problem is especially severe in grades K-6, where effective elementary science instruction is needed to provide a sound basis for subsequent science study. Research revealed that the principal's support is essential to the success of any school program. The Elementary Science Education Institute provided for joint preparation of four-member teams of two elementary teachers, their school principal. and their supervisor of instruction from rural Tennessee schools to insure the understanding and support needed for local leadership in improvement of science instruction. The purpose of the Institute was to prepare nine teams per year over three years to generate 27 nuclear leadership units across the state. The project goals included: (a) improving the participants' content and instructional skills; (b) providing a program for supervised research and planning of individual team practica culminating in a one-year filed project to be conducted in each term's educational service district; and (c) providing a field-support system to nurture the teams' field projects and document the effectiveness of the Institute in the elementary science education arena. This program will explicate the Elementary Science Education Institute model and review the evaluation of the 1987-88 Institute.

A FOCUSED APPROACH FOR TEACHING CHEMISTRY IN NURSING SCHOOLS IN ISRAEL USING CASE STUDIES

Yehudit J. Dori
Computer Architecture
University of Kansas
Lawrence, Kansas

"Chemistry anxiety" exists amongst nursing students as well as other allied health professions. The causes for this anxiety may be attributed to the facts that chemistry is perceived as difficult, it involves a multitude of facts, and is not attached to reality (irrelevant).

There is no miraculous solution to this cognitive and motivational anxiety problem. Nevertheless, a practical solution which copes with the obstacles of teaching chemistry to nursing students, is presented. A chemistry curriculum for nursing schools, based on a focused approach to the subject, was developed.

To overcome the difficulty, intensive exercises were written and teaching aids developed. A careful selection of only those topics that are necessary for understanding the principles in the more advanced courses, i.e. pharmacology, was aimed at diminishing the number of facts involved in the study of chemistry to a minimum. The selection of topics is based on both recommendations of educators found in the literature and on the findings of the needs assessment study. The usefulness of the information gathered from nurses and doctors is enhanced by the fact that they were actively engaged in patient care at the time they responded to the needs assessment questionnaires.

Finally, relevance to nursing was obtained by the introduction of a varied selection of medical and nursing case studies. The examples from a nurse's everyday work included, among other case studies, revival of a patient hurt in a traffic accident and the diagnosis of metabolic acidosis by testing the pH of the blood. These case studies contributed to the improvement of the image of chemistry, as they demonstrated the close relationship between chemistry and nursing. Moreover, they establish the contact between the abstract ideas presented by the "pure" chemistry to the real, everyday life of the nursing students' future profession. Ideas for many of the case studies included in the curriculum were adapted using suggestions of nursing instructors, who have an excellent perspective as to the most necessary needs of clinics and hospitals.